once, frequently from internal and unseen imperfections.

The many great failures in cast-iron girders in the manufacturing districts, and the experiments to ascertain the best form for the Holyhead tubular bridges, induced Mr. Fairbairn of Manchester to consider this subject, and in 1845 he patented a beam formed with two webs connected by upper and lower flanges, riveted in each direction, the whole being in the form of fig. 1; the tendency of the webs to bulge or collapse being counteracted by short transverse pieces of tubing, through which pass rivet bolts. The experiments, however, of Mr. Fairbairn and Mr. Hodgkinson, showed that there was a limit to the reduction of weight in wrought-iron beams, when used in thin and light forms: thus the compressibility of cast-iron is probably never less than 50 tons per square inch, while, in their experiments on rectangular wrought-iron tubes, formed of plate ¼ inch, ⅛ inch, and ⅛ of an inch thick respectively, the resistance to compression per square inch was only 19½, 14½, and 7½ tons. This great reduction in strength by the use of thin metal was caused, not by want of resistive strength, but from want of stability. The result of the experiments above referred to, is the very general introduction of tubular wrought-iron girders for railway bridges, but the price (from 28*l.* to 32*l.* per ton) must render them, without some modification, too expensive for ordinary use in buildings. It occurred then to the author of the floor which is described in this paper, that if some form could be adopted where advantage was taken of the full tensile strength of wrought-iron, while at the same time by insuring its stability power to resist compression were given, then it might be used very economically. No stronger construction was then known than the combination of square cells used for the floor of the Conway tubular bridge—a form of construction, however, far too expensive for ordinary floors, from the cost of riveting the top sheet of iron, especially on a small scale. After some consideration, experiments were made to determine the effect of a combination of iron for tensile and some other material for compressive strength, and several beams were made of the form fig. 2, where *a* is a T beam of sheet-iron suffened by brickwork, as shown at *b*; but it was found on loading these that the bricks cracked and slipped off, in the manner indicated in the figure, showing that the mere resistance of brickwork to longitudinal pressure would not practically be of any value.

*Fig.* 1.

*Fig.* 2.

A rectangular tube was then selected, after one in Mr. Hodgkinson's experiments, formed of malleable iron 1-16th of an inch thick, 6 inches deep, 4 inches wide, and 7 feet 6 inches bearing; the top plate was omitted, but tie-bolts were placed at intervals, connecting the sides, and the whole was filled in with concrete; the weight to break this down, when hung in the centre, was 7,206 lbs., the same tube empty, but with a top plate, was, by Mr. Hodgkinson's report, crushed with 3,156 lbs.

In the above experiment the failure was by the sides of the tube bulging outwards at the centre, and it suggested itself, that if there had been concrete outside as well as inside, the bulging would not have occurred. A model was therefore constructed of sheet and angle iron of the dimensions shewn in Fig. 3, the part lightly shaded being filled in with concrete; the bearing was 12 feet, and the breaking weight in the centre 5 tons 14 cwt., the bottom of the beam having been torn asunder without the slightest buckling of the vertical plates.

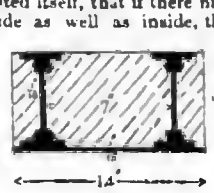

*Fig.* 3.

A beam of similar construction 23 feet bearing, and 13 inches deep, was made of sheet iron, 1-12th inch thick; the weight of iron altogether in this beam was 656lbs., and it carried 12 tons equally distributed (including the weight of concrete), for several weeks, with a deflection of 1¼ inch, 1 inch of which recovered itself on removing the weight, a large portion of the remaining ¼ inch being due to a defective scarf. The weight of a cast-iron beam capable of supporting this load would be 1,800lbs. These experiments and numerous others seemed to shew that the uniform pressure of concrete against the whole surface of the web, and under the top flanges of the beam, would produce the effect of a continuous strut, and thus enable comparatively thin plates to assume the true character of a beam or girder.

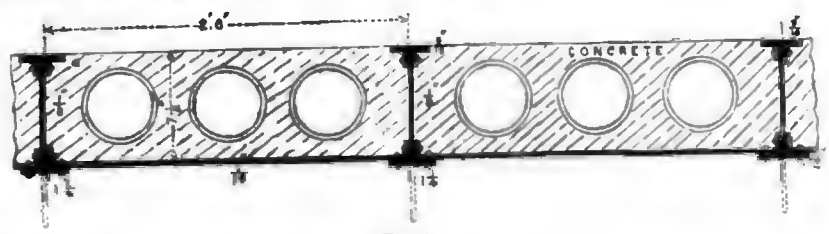


*Fig.* 4.

Fig. 4 shews the form of construction proposed by Mr. Beardmore, as evolved from the above and other experiments; for floors up to 18 feet span: it is constructed of vertical plates of sheet iron, with angle iron rivetted through. These light beams are then placed on the walls at the proper distances, and plates are rivetted to the bottom angle irons, and the whole filled in with concrete. Lightness may be obtained by introducing earthenware pipes, or this object may be effected by lengthening the vertical webs (as shown by dotted lines), when the floor may have a less thickness of concrete. The bottom plates, when liable to corrode, may be either of galvanised iron,* or iron coated with the peroxide paint patented by Mr. Welch.

The weight of the above floor, contrasted with one formed with cast-iron girders and half-brick arches, is shown in the following table:—

| | Per square. | Per foot. | Span. | Depth of floor. |
|---|---|---|---|---|
| | lbs. | lbs. | feet. | inches. |
| Floor formed with cast-iron beams and half-brick arches:— | | | | |
| Cast iron | 1,004 | 18.1 | 15 to 18 | 14 |
| Brick, &c. | 5,774 | 50.2 | | |
| | 6,833 | 68.3 | | |
| Fig. 5, as described above:— | | | | |
| Wrought iron | 600 | 6.0 | 15 to 18 | 7½ |
| Concrete, with earthenware pipes | 4,972 | 49.7 | | |
| | 5,572 | 55.7 | | |

The concrete used in all these experiments was formed of White's Portland cement and shingle, in proportions of from 1 and 6 to 1 and 9. The cost of such is less than good brickwork, and is remarkable from its setting properties and strength to resist compression.

The following is the inventor's summary of the apparent advantages of the proposed mode of construction:—

1. The necessity of the floor being fire-proof from its mode of construction.

2. The non-liability to disintegrate when exposed to fierce flame, as brick arches are known to do, in flakes.

3. That being of malleable iron, its cohesion could not be destroyed by sudden cooling when heated.

4. The small depth of this floor when contrasted with one of cast-iron of equal strength.

5. The absence of all lateral pressure on walls, and consequent necessity for tie bolts: and,

Lastly, that whereas in cast-iron constructions it is necessary to calculate the beams to bear not only the weight of the expected traffic on the floor, but also the weight of the brick arches themselves; in the proposed mode the concrete is not a weight independent of the floor which it is required to sustain, but a necessary element of the floor itself, thus rendering it nearly impossible to accumulate a great weight on any one spot, the floor being as it were one continuous beam, while with cast-iron girders the weight in the entire floor is necessarily thrown on them alone, which are consequently strained beyond the average strength required.

* We have received several serious statements relative to galvanised iron, to which we shall give attention.

## NOTES IN THE PROVINCES.

THE prior's tomb, in the chancel of the church of St. Nicholas, Yarmouth, was opened on Monday week, and found to contain, in a white Purbeck marble coffin, a skeleton in good preservation, but evidently disturbed during a previous opening, it is supposed in 1650. No chalice, pastoral staff, &c., were found, though other traces of high ecclesiastical rank are said to have been noted.——"A house agent in this town," says a Leicester paper, "has threatened to turn out every tenant of dwelling houses of which he has the management, who calls the attention of the inspectors of nuisances to any nuisance on the premises they occupy." We know, too, of instances in which tenants themselves refrain from complaint of nuisances from the mere anticipation of disagreeable contact with their landlords. It is to be hoped, however, that a little moral courage on the one hand, and a little forbearance on the other, will gradually work out much sanitary benefit. We can readily conceive that landlords may be much annoyed with complaints and expense without great reason, but where a wholesale threat like the above is uttered *in terrorem*, as a gag to tenants suffering from nuisances, it is also to be hoped, and indeed it is highly probable, that every house so tabooed from all cleansing process will become a "noted house" in its neighbourhood, into which tenants will be as afraid to enter as if it were haunted, or the scene of some recent slaughter; so that its landlord or agent may be as much induced to adopt as effectual means for turning in a tenant as those now threatened may, to his chagrin, *really* prove to be in turning him *out*.——Gloucester Cathedral lately stood in imminent peril, from fire in the college school-room over the chapter-room. One of the stoves is supposed to have set fire to the floor, which was much burnt, while books in flames fell into the chapter-room below.——The Mariners' Chapel at Gloucester was opened on Sunday week. The *Journal* describes it as a simple and appropriate structure. Mr. Jacques, of Gloucester, was the architect, and Mr. William Wingate, also of the same city, was the builder.——The Macclesfield committee for erection of baths and washhouse have selected the plan for a building at an estimated cost of about 1,200*l.*——St. John's Church, Hurst, was consecrated on Monday week. It is in the Early English style of 13th century. Internally it is about 69 feet long by about 43 feet wide, and divided into a nave and side aisles. It is without clerestory. The chancel is about 18 by 19 feet, with a vestry on the north side. In the west gable are two lofty lancet windows, with a quatrefoil light, surmounted by a plain bell turret, rising upwards of 50 feet from the ground. Near the south-west corner, on the south side, is a porch with high gabled roof. The nave pillars are of polished stone, the pews are low, and the roofs are open timbered stained in oak. There is a small gallery. Sittings in all 750. Mr. E. H. Shellard, of Manchester, was the architect, and Messrs. Eaton and Hallas, stone-masons, were the contractors.——Styd Church, Ribchester, is to be renovated.——The Bradford council have formally discussed the smoke nuisance, and appointed a smoke committee.——The works connected with the new Mechanics' Institute, in the city of Durham, have been commenced; and the building will be finished, it is thought, in October next.——The large hospital to be